BIOLOGICAL SURVEY

OF THE

HOLLAND RIVER

1965

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ONTARIO WATER RESOURCES COMMISSION

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by
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INTRODUCTION

Changes in the characteristics of water which adversely affect the amenities of a watercourse are usually associated with changes in plant and animal communities. The extent to which these communities are changed indicates the degree of alteration of water quality and, furthermore, reflects conditions in the watercourse through several months prior to the biological survey. Biological data also provide a useful baseline against which future changes in water quality may be compared and assessed. With these considerations in mind, a biological survey of the Holland River including its important tributary, the Schomberg River, was carried out in July, 1965.

DESCRIPTION OF THE HOLLAND RIVER

The Holland River flows from the northern slope of the Oak Ridges interlobate moraine through land of rather irregular topography in the area of Aurora and Newmarket to the Holland Marsh which occupies part of the basin of glacial Lake Algonquin. Therefore, the headwater streams are steep in gradient and most are fed by springs, while the two major tributaries, the Holland and Schomberg Rivers, have very low gradients throughout the lower reaches in the

Holland Marsh. The two major canals of the Schomberg River serve to divert water for horticultural use to the northern and southern borders of the developed Marsh.

The upper Holland River, through Stations A, B and C was 5 to 8 feet wide at the time of the survey, up to 3 feet deep in pools and shallow in areas of riffles. The tributary which flows through Aurora was 4 to 15 feet wide and 1/2 to 1-1/2 feet deep at Stations D to G.

The Holland River above Newmarket at Station H was 30 feet wide, up to 4 feet deep and evenly flowing. The river was similar in character below Newmarket. However, below Holland Landing it becomes much wider, deeper and slow flowing; at Station K the river was 150 feet wide, 9 feet deep with a velocity of no more than 1/2 fps. Aquatic vegetation, both submergent and emergent, was abundant at the time of the survey.

The streams feeding the Schomberg River were relatively small ones, 5 to 12 feet wide, up to 2 feet deep with both sluggish and rapidly flowing sections. The Schomberg River is diverted in canals approximately 60 feet wide and 8 feet deep at Stations O, P and R.

The Schomberg River below Bradford was 150 feet wide, 9 feet deep and vegetation was abundant including the pondweeds, Potomageton spp., coontail, Ceratophyllum sp.,

bladderwort, Utricularia sp., waterlily, Nuphar sp., as well as many emergents.

Two major sources of municipal wastes are Aurora and Newmarket. Aurora (population 9,200) has two activated-sludge plants with a combined capacity of about 1 mgd. The effluent is discharged to a tributary of the Holland River above Station E (Fig. 1). Newmarket (population 8,100) has a new activated-sludge treatment plant which discharges 1.5 mgd of secondary effluent to the Holland River above Station I. A much smaller amount of treated sewage is derived from Bradford (population 2,370). Overflow from the 10-acre lagoon goes to the Schomberg River in the vicinity of Station S.

The Holland Marsh is used intensively, especially that part between Bradford and Schomberg, for the production of a variety of vegetable crops, particularly onions and carrots. Several pesticides are used in their production including almost weekly applications of DDT and periodic use of organo-phosphorus materials (Parathion, Malathion, Phosdrin, Diazinon). Some Sevin is used but little aldrin and dieldrin. A variety of herbicides is used including herbicidal oil and Lorox on carrots and CIPC, Randox and Herbasan on onions.

Major industries in the area include a tannery at

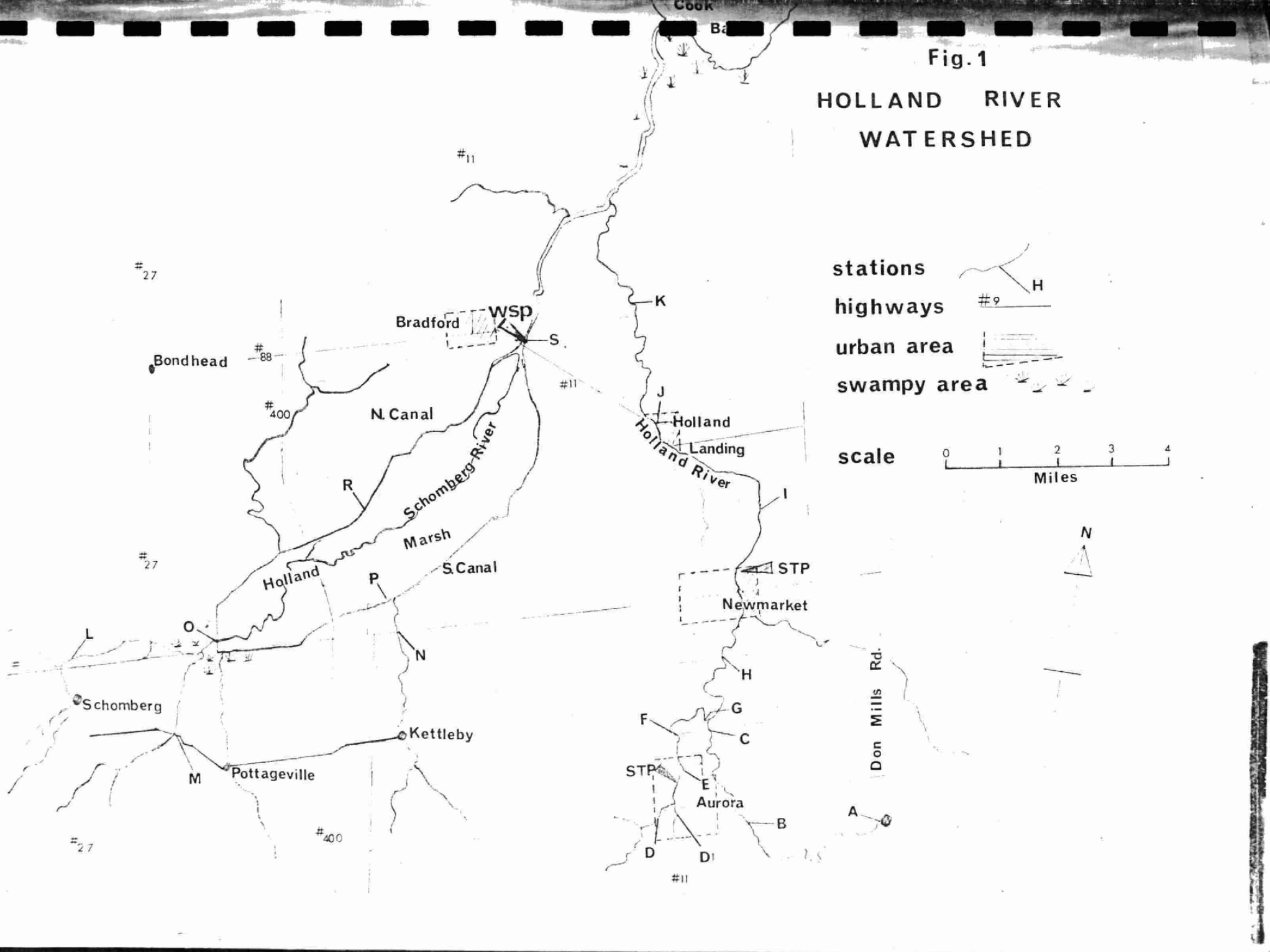
Fig. 1
HOLLAND RIVER
WATERSHED
stations
highways
urban area
swampy area
scale
0 1 2 3 4
Miles
N
Cook
Bradford
WSP
S
K
Bondhead
#88
#400
N. Canal
Schomberg River
R
Marsh
S. Canal
Holland
P
O
L
N
Schomberg
Kettleby
M
Pottageville
#27
#11
J
Holland
Landing
Holland River
I
STP
Newmarket
H
G
F
C
STP
E
Aurora
B
A
D
D1
Don Mills Rd.

Aurora which disposes of wastes through the sanitary system to the municipal treatment plant and several food packing and processing plants at Bradford which provide little if any treatment to process water which is discharged to the Schomberg River.

Therefore, the points of major interest in the biological survey were as follows: the effect of municipal and industrial wastes on the Aurora tributary of the Holland River, the effect of that tributary on the Holland above Newmarket, the effect of municipal waste from Newmarket and, finally, the effects, if any, of agricultural chemicals and food process wastes on the Schomberg River.

METHODS

Fish and invertebrates were collected at each station. Invertebrates were collected during a period of 20 minutes with a hand seine (20-mesh/inch) from all habitats at each station which could be waded; otherwise two Ekman dredge samples of bottom sediments were taken at each of the downstream, deep-water stations. The invertebrates were removed by screening, preserved and examined subsequently in the laboratory. Fish were collected by electrofishing for approximately 20 minutes at each upstream station which could be waded. A 25-foot seine was employed at Stations I and J and a 100-foot bag seine was used at each of the

wider, deeper stations. Two to four hauls with the seine were adequate in indicating the relative abundance of fish and species composition of the population.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

The biota of the Upper Holland River included moderate numbers of a variety of macroinvertebrate and fish species. Stations A, B and C were similar. Eleven species of fish were taken at the three stations; the common sucker and creek chub were most numerous at each. Ten to 15 taxa were found in the bottom fauna community, of which about one-half were forms intolerant of impaired water quality. Figures 2 and 3 illustrate the general characteristics of the fish and bottom fauna communities. The stream was in a satisfactory condition above the confluence of the Aurora tributary and the communities there may be compared with those further downstream which were obviously affected by domestic pollution.

The three stations on small headwater streams of the Schomberg River also contained an assemblage of fish and macroinvertebrates indicative of fair to good water quality.

Stations D and D1, which were located on separate streams which converge and form the Aurora tributary, were examined. The stream at Station D contained several

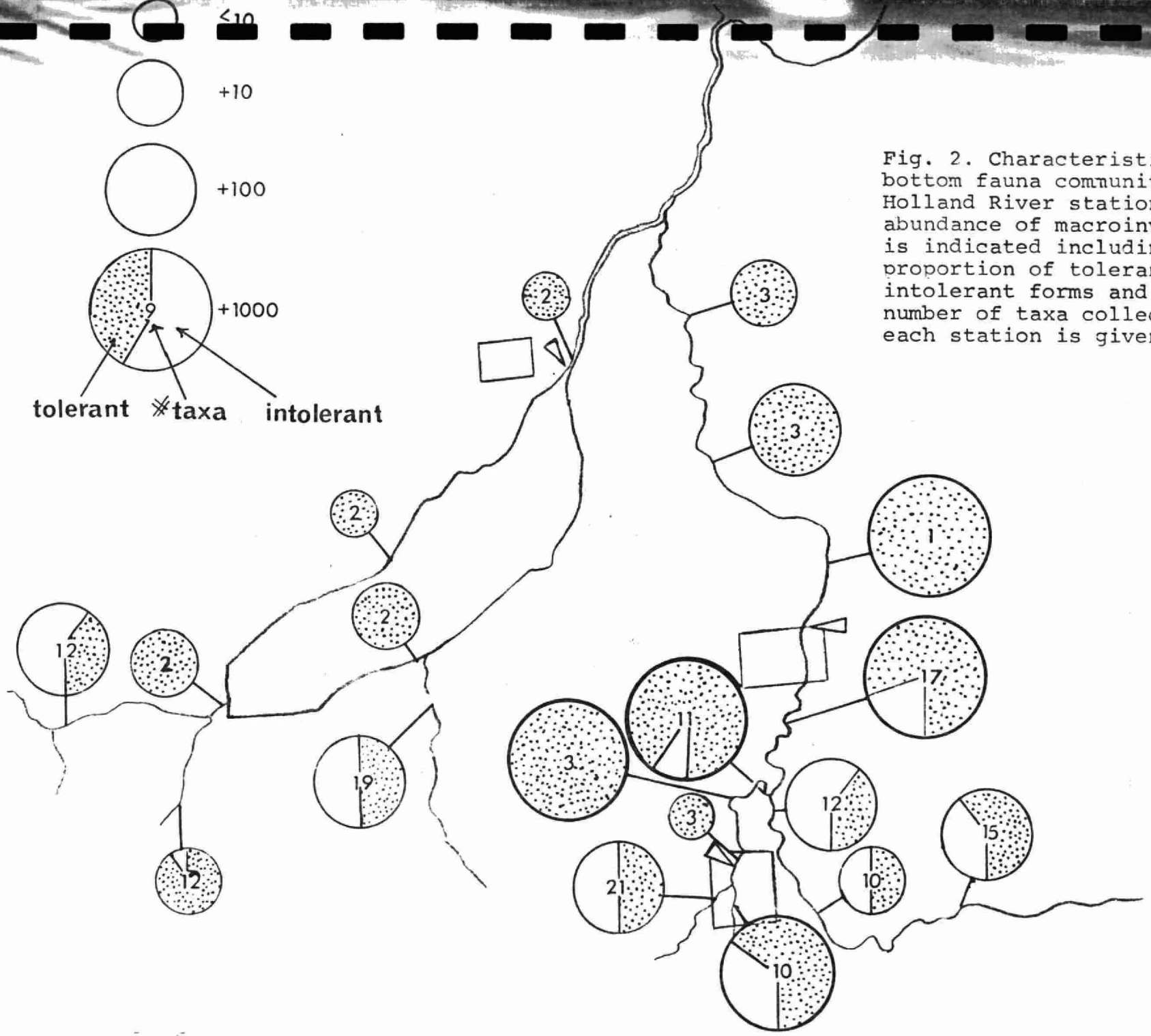

Fig. 2. Characteristics of bottom fauna communities at Holland River stations; the abundance of macroinvertebrates is indicated including the proportion of tolerant and intolerant forms and the number of taxa collected at each station is given.

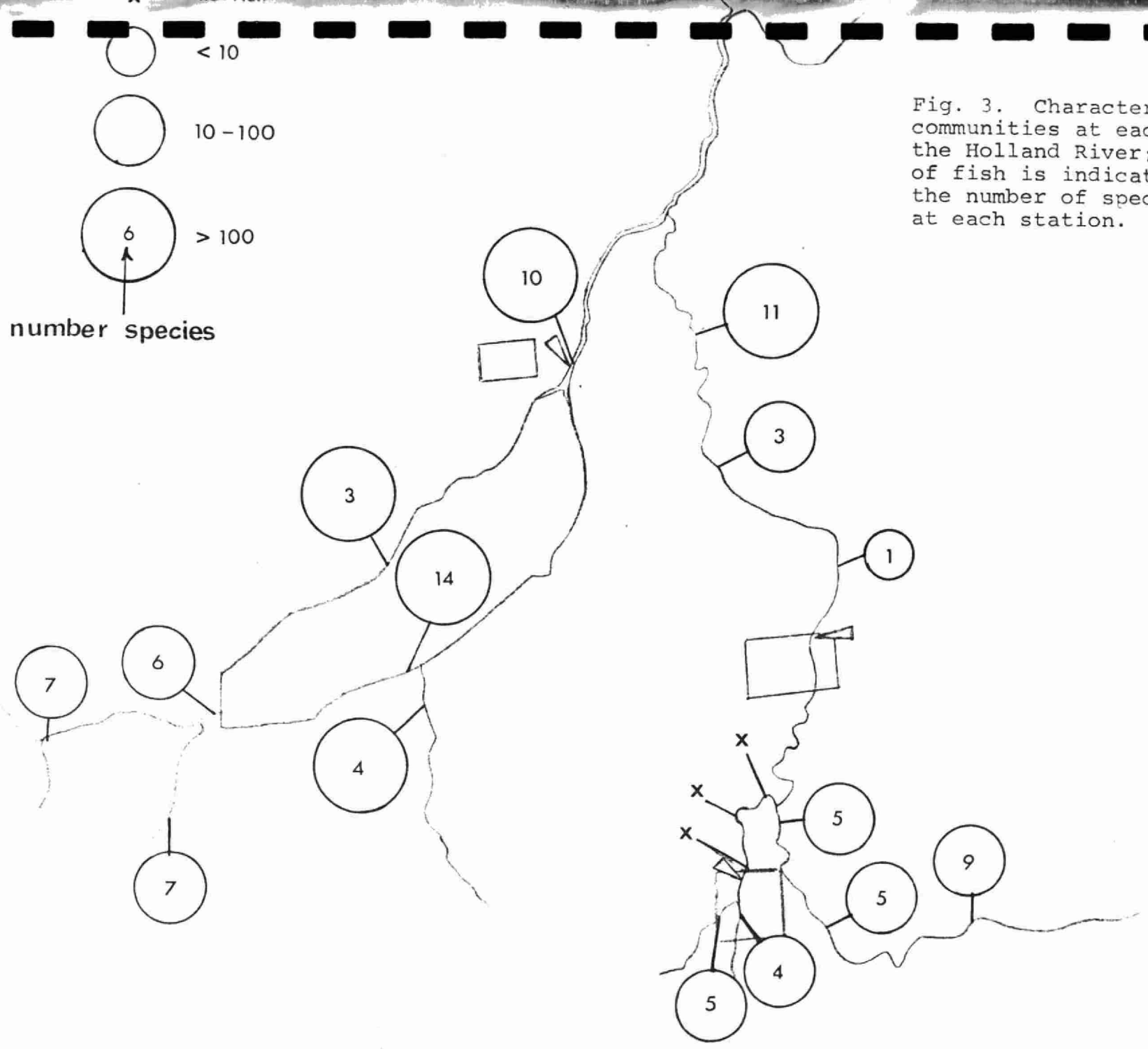

Fig. 3. Characteristics of fish communities at each station on the Holland River; the abundance of fish is indicated as well as the number of species collected at each station.

species of fish and several invertebrate taxa intolerant of domestic pollution. However, an extremely large population of sludgeworms was present at Station D1 where intolerant mayflies were absent and, therefore, organic enrichment, possibly from the tannery upstream, was evident.

Only slight improvement was noted in the condition of the Aurora tributary above its confluence with the Holland River. Large numbers of midge larvae (bloodworms) and the absence of all intolerant forms found at the stations described previously demonstrated the heavy organic contamination of this small stream at Station F. Some moderately tolerant forms returned at Station G but the tolerant midges occurred in extremely large numbers and no fish were collected.

Water quality of the Holland River below the Aurora tributary was poor as the effects of wastes from Aurora were obvious in the abundance of tolerant macroinvertebrates and absence of mayflies. A total of 17 taxa was found at Station H but more than three-quarters of these were organisms which may be associated with moderate to heavy contamination by organic wastes.

Further deterioration in the Holland River was evident at Station I below Newmarket. Although the character of the river changes at that point to a more

sluggish, deeper and wider stream and fewer macroinvertebrate taxa are to be expected there, the bottom fauna community consisted solely of midges which were extremely abundant. No significant improvement in the biota was noted in the Holland River above Bradford but considerable assimilation obviously took place because the standing crop of midges had decreased markedly by Station J and again at Station K.

Only pollution-tolerant macroinvertebrates were found in the sediments of the Schomberg River canals. In fact, only midge larvae and sludgeworms were collected although some other invertebrates were observed in association with vascular plants which grew in abundance throughout much of the canals. No mayflies, amphipods or other invertebrates which demand water of fair to good quality were observed, although they could be expected to occur there. These waters are probably well supplied with nutrients because of their proximity to intensively fertilized cropland, and, in view of the fact that aquatic vegetation is dense in most areas, water quality probably deteriorates beneath the ice each winter as the plants decompose. There is no direct source of organic enrichment in the vicinity other than the muck soils of the marsh, which also might exert a demand on the dissolved oxygen supply.

Station S was located not far below the Bradford

lagoon effluent ditch, and conditions there were no different than in the canals upstream.

Apparently, considerable quantities of process and wash water, with a relatively high BOD, are discharged to the Schomberg River at Bradford. The effects of these discharges may be far-reaching, in fact, they may influence water quality in the canals. Because of the extremely low gradient, the level of Lake Simcoe (Cook Bay) must influence the direction of flow in the lower Schomberg River. Upstream circulation, even if it occurs only periodically, is certain to make difficult the establishment of any relationship between impaired water quality and any particular source of organic loading. Consequently, all that can be stated is that water quality was impaired in both the lower Holland River and Schomberg River and, because of the poorly defined pattern of flow, all sources of organic wastes could add to the total loading at almost any point upstream or downstream at any time.

The fish population of the canals was both varied and abundant except at Station 0, the station furthest removed from the lower Holland from which many of the fish could spread into the canals. The golden shiner, roseyface shiner, bluntnose minnow and white sucker were the most common species in the canals. The yellow perch was by far

the most common fish at Station S.

The catches of fish obtained during the course of the survey indicated that water quality was good at the time of the survey. However, because the poorest water quality is expected to occur beneath ice in the winter months, the results are of less significance than data on relatively immobile bottom-dwelling macroinvertebrates.

Fish mortalities, sometimes of considerable proportions, have occurred in the Holland River. Although the cause of these has not often been clearly indicated, it is evident that the lower river is an extremely rich but marginal habitat for fish. Probably the habitat is least suitable in winter, rather than in the other seasons, because of the sluggish, weedy nature of the watercourse. This is a natural characteristic but one which has been amplified by the wastes of about 20 thousand people and the loss of nutrients from a large area of heavily fertilized and intensively irrigated organic soils.

Therefore, the Holland River was found to be in rather poor condition below the confluence of the Aurora tributary, which also was decidedly contaminated. No recovery was noted below Newmarket and through Holland Landing. The Schomberg River was in only fair condition and indications of significant organic loading were observed. The head-

water streams of the two rivers appeared to be in good condition, except one of the two streams which flows through the Town of Aurora.

Samples of bottom sediments, water, net plankton, macroinvertebrates and fish were collected at Stations O, P R, at one station in Cook Bay and at two stations on Lake Simcoe for analysis of pesticides. Obviously, where such an intensive horticultural industry is quite close to a valuable and extensively exploited sport fishery, an investigation of the levels of certain widely employed and biologically important pesticides in fish is necessary. These results will be provided in report form when the analyses have been completed.

The bottom fauna of Lake Simcoe were sampled at a large number of stations in 1965 and some collections were made in the winter in 1966. Considerable laboratory work will be required to analyse these samples of macroinvertebrates in the detail required to make a thorough comparison with the findings of the late Dr. D. S. Rawson who described the bottom fauna and some aspects of water chemistry about 40 years ago [1]. The comparison should be a most informative one.

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[1] Rawson, D. S. 1930. The bottom fauna of Lake Simcoe and its role in the ecology of the lake. U. of Toronto studies, Ont. Fish. Res. Lab. No. 40:183pp.

Appendix A

Table 1. Specimens taken from stations on the Holland River, 1965. Collecting methods are outlined in the text of the report.

General Class	Stations A	B	C	D	D1	E	F	G	H	I*
STONEFLIES										
Perlesta			1							
MAYFLIES										
Callibaetis		2		1						
Baetis		4	4	7			1			
Caenis				1						
Neocloeon	5									
CADDISFLIES										
Hydropsyche		1	20							
Cheumatopsyche		1	20							
Neophylax				1						
Pycnopsyche					1					
DAMSELFLIES										
Enallagma									4	
DRAGONFLIES										
Agrion	1									
Anax	1									
Cordulegaster				1						
DIPTERA										
Tendipedidae	73	13	13	63	53	78	657	6854	1388	1219
Chrysops	3	1		2						
Palpomyia			1					8	29	
Simulium				9						
BEETLES										
Berosus									1	
Dubiraphia	5			3						
Hydroporus	1			1					3	
Laccophilus	1							2	7	
Agabus	1								1	
Hydrobius				41						
Oreodytes				1						
Tropisternus				1						
Haliplus									1	
Rhantus									3	
Agabinus								2		
Unidentified adults	4	4	8	18	1	3		6	15	
ISOPODS										
Asellus					2			42		

Table 1. (continued)

General Class		Stations A	B	C	D	D1	E	F	G	H	I*
AMPHIPODS											
Hyallela		1			1	3			34		
BUGS											
Corixidae		185	4	57	105	1			4	5	
Saldidae					1				2		
Ochteridae										2	
Trepobates					1						
LEECHES											
Unidentified	A					2					
	B					1					
	C								6		
	D									7	
	E									1	
MOLLUSCS											
Sphaerium		6	1	32	8						
Pisidium					5						
Physa		1	1							9	
Helisoma				1							
DECAPODS											
Unidentified crayfish		11		14	1	4					
SLUDGEWORMS				3		1187	7	11	74	39	

*Total of 2 Ekman-dredge collections

Table 2. Specimens collected from an additional 10 stations on the Holland River and its tributaries in July, 1965. Collecting methods are described in the text of report.

Taxa	Stations J*	K*	L	M	N	O*	P*	R*	S*
MAYFLIES									
Tricorythodes					18				
Baetis				17	10				
Neocloeon					2				
Callibaetis			1						
CADDISFLIES									
Hydropsyche					1				
Pycnopsyche					2				
Lepidostoma					4				
DAMSELFLIES									
Ischnura			4		1				
DRAGONFLIES									
Agrion					2				
DIPTERA									
Tendipedidae	49	8	104	39	97	4	12	7	2
Simulium			19	1	3				
Chrysops				2					
Dixa				1					
ALDERFLIES									
Sialis									
BEETLES									
Oreodytes				1	1				
Rhantus				1					
Agabus				2					
Laccophilus			2						
Adults Unidentified			3	9	7				
Hydrobius					3				
ISOPODS									
Asellus	97	3							
AMPHIPODS									
Hyallela			41		12				
BUGS									
Corixidae			81		10				
LEECHES									
Unidentified A			1						
B					3				

Table 2. (continued)

Taxa	J*	K*	L	M	N	O*	P*	R*	S*
MOLLUSCS									
Physa			30		3				
Helisoma					1				
DECAPODS									
Orconectes			15	2					
SLUDGEWORMS									
Unidentified	172	2	2	2	15	13	4	3	7

*total of 2 Ikman-dredge collections

Appendix B

Table 1. Catches of fish taken from 8 stations on the Holland River July, 1965. Collections were made at A to D1 by electro-fishing for 20 minutes, at I and J with a 25-foot seine net and at K with a 100-foot bag seine.

Species	Stations							
	A	B	C	D	D1	I	J	K
Central mud minnow	1							
White sucker	19	41	47		4		22	4
Northern hog sucker				1				
Carp								
Redbelly dace	25						6	4
Blacknose dace	2	3		30	1			
Longnose dace		5	1	2	2			
Fathead minnow	11		8					11
Bluntnose minnow			2					2
Creek chub	21	22	25	19	10			
Rosyface shiner								125
Golden shiner								130
Brown bullhead								1
Brook stickleback	1					1		
Trout perch								30
Pumpkinseed								30
Yellow perch							1	43
Sauger								1
Mottled sculpin	8	5		26				
Total fish	89	76	83	78	17	1	29	381
Total species 19	9	5	5	5	4	1	3	11
Number of seine hauls						4	3	3

Table 2. Catches of fish taken at 7 stations on the Schomberg River and Holland Marsh Canals, July, 1965. Collections were made at L, M and N by electrofishing for 20 minutes and at O, P, R and S using a 100-foot bag seine net.

Species	Stations L	M	N	O	P	R	S
Central mud minnow		1					
White sucker	1	3		1	77		2
Blacknose dace	4		69				
Longnose dace	11		76				
Pearl dace		7					
Redbelly dace							2
Golden shiner				2	230	52	80
Rosyface shiner					239	82	96
Blacknose shiner					31		11
Spottail shiner					4		
Common shiner	1				13		
Bluntnose minnow	2				53		8
Fathead minnow		5			16	1	6
Creek chub		14	8	1	9		
Brown bullhead				1	2		
Brook stickleback		2		2			
Pumpkinseed	4				10		9
Smallmouth bass					3		8
Johnny darter	3	1	7		2		
Yellow perch				6	31		785
Total fish	26	33	160	13	720	135	1007
Total species 20	7	7	4	6	14	3	10
Number of seine hauls				3	3	2	3